

# SANDPAPER ITS HOW AND WHY



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# SANDPAPER ITS HOW & WHY

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BEHR-MANNING  
TROY, N. Y.  
(DIVISION OF NORTON COMPANY)

NORTON ABRASIVES

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TROY, N. Y.

## P R E F A C E

Everybody who uses a tool or supply article is always interested in what it is, how it is made and the best way to use it. This is especially true of the pupils in Manual Training and Vocational Schools and the user in the home. It is to answer these three general questions that this little book on Abrasive Papers and Cloths is published.

It is also intended to divert the user from materials he may be using to those proven more efficient in that exacting laboratory—the large industrial plant.

Technical details have been kept to the minimum and only the most interesting and instructive features are included and in the simplest form possible.

*“Lightning,”* pages 26 and 27, and *“Closekote”* and *“Openkote,”* on page 28, are particularly called to the reader’s attention.

# ABRASIVE PAPERS AND CLOTHS ("SANDPAPER")

## HOW THEY ARE MADE

### *The Minerals*

**T**here are five different minerals used as the cutting agents — three natural and two manufactured.

The natural minerals are:

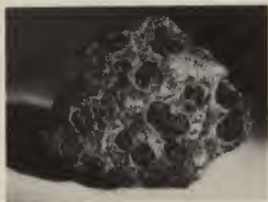
1. QUARTZ (commonly called Flint), generally of a yellowish cast when seen on the finished sheet of paper.
2. GARNET — A tawny red.
3. EMERY — Dull black.

The manufactured minerals are:

1. SILICON CARBIDE — Shiny steel gray to black.
2. ALUMINUM OXIDE — Brown.



QUARTZ is found in most of the states of this country.

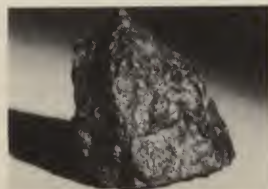


GARNET of the best abrasive quality is mined in the Adirondack mountains of New York State.

EMERY (no illustration) comes from Turkey and Greece.



SILICON CARBIDE, the principal ingredients of which are silica sand and coke, is the product of an electric furnace operated at extremely high temperature.



ALUMINUM OXIDE, also the result of fusing in an electric furnace, has as its base Bauxite, a natural mineral.

## *The Backings*

Three general classes of backings are used:

Paper

Cloth

Combination [light cloth and paper joined]

Paper is by far the most used. Cloth second, and Combination of only slight general interest.

Six or seven weights of paper are employed and two standard weights of cloth—all dependent upon the use for which the finished product is designed. The more severe the strain, the heavier the paper or cloth backing.

Aside from the element of strength, cloth is also called into service because of its pliability and ready conformation to curved surfaces.

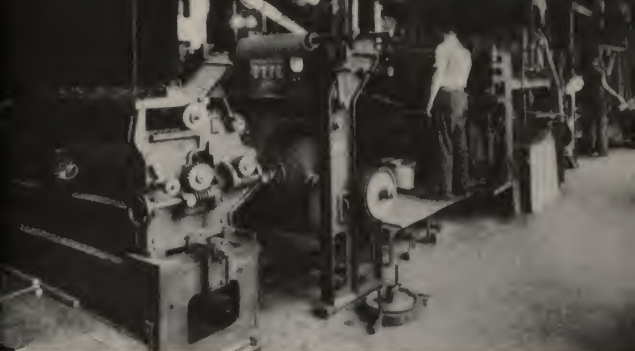
## *The Adhesive or Bond*

Best quality hide glues are used for holding the abrasive kernels to the backing, except in the case of waterproof products in which resins are the binding agents.

## *Crushing and Grading the Abrasives*

The various minerals in crude lump form are fed into jaw and roll crushers, and come





THE COATING MACHINE

out a mixture of all sizes from finest dust to the coarsest grit size.

The resulting mixture is then separated by means of sieves or screens into the many definite sizes required. The sieves are made of silk bolting cloth woven by hand in Switzerland.

### *The Coating Process*

Having all the ingredients ready—the mineral crushed, the glue solutions at the requisite composition and temperature and the paper or cloth in huge rolls—we next see the making process.

In the coating machine, the backing, glue and abrasive grain are combined and a finished strip of abrasive paper or cloth, from 24" to 48" wide and from one to five miles long, emerges with the grit in a smooth, even layer embedded in a firm bond.

It is then partially dried, when a second and thinner sizing coat of glue is applied over the abrasive surface. This mingles with the first coat of glue and further insures rigid holding of the grain.

### *Drying*

After the product leaves the sizing machine, it is carried by traveling racks through the drying rooms. Here the temperature and humidity are under the most careful control and the air is constantly being renewed. Regulated drying is all-important to the final efficiency of the product.

### *The Cutting Rooms*

This is where the web of abrasive paper or cloth is mechanically cut into sheets for hand use or to the many narrow widths required for the various sanding machines using it in endless belt form.

DRYING RACKS



SLITTING MACHINE





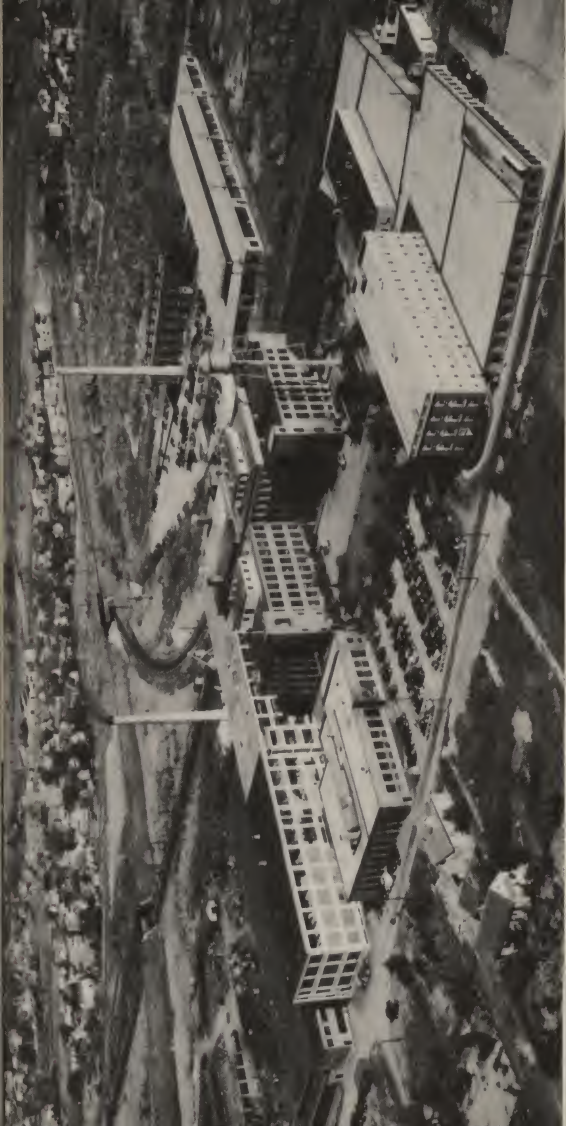
### *Storage and Shipping Rooms*

Here the material in its finished form, rolls from 1" to 48" in width and fifty yards long and sheets of the standard commercial sizes, is stored and shipped. Atmospheric conditions are carefully regulated in these rooms also.

### *A Modern Abrasive Paper Plant*

In order that anyone may more clearly visualize the size and scope of a modern "Sandpaper" factory, we present, on the next page, an air view of the Behr-Manning plant, post office address, Troy, N. Y., U. S. A.

The plant and auxiliary buildings cover about seven acres and contain a total of more than twelve acres of floor space.



AIRPLANE VIEW OF PLANT (OVER 15 ACRES OF FLOOR SPACE)

## “WHAT TO USE”



### *Garnet Abrasives in Wood Working*

**I**n industry, the natural mineral Garnet long ago superseded Flint, even for hand sanding. Garnet coated on paper and cloth made its appearance in the early eighties, and industry, always ready for anything that will reduce costs, was quick to see its possibilities. Soon it was demonstrated that Garnet Abrasives used for machine sanding (drum sanders and belt sanders) resulted in a lower finishing cost PER UNIT, although their original prices were higher than Flint. This was due to the harder, sharper mineral.

Naturally, this led to experiments with Garnet Paper *for hand use* and the result was the total elimination of Flint Paper in the wood-working industry.

Notwithstanding the many different machines that have been invented to do the sanding which was formerly accomplished by hand labor, there is still a great quantity of Paper so used. The most popular is Garnet Paper No. 0, closely followed by 2/0. No. 3/0

is also used for finer work and No. 1/2 may be found in use for quick cutting where finish is not so important or where the work is to be re-sanded with a finer number.

Garnet grit numbers compare with Flint Paper numbers about as follows:

GARNET	FLINT
No. 1/2 equals	1-1/2
No. 0	1
No. 2/0	1/2
No. 3/0	0

See page 29 for full comparative grading chart.

## *The Purpose of Sanding*

### *With illustrations of some common methods*

All sanding is done to prepare the surface for the final finish with stain, filler, shellac, varnish, lacquer, wax, or whatever is chosen for the purpose. The surface should be level and smooth. To get the best results by hand, use a block of rubber, cork, felt, or even wood covered with some material which will give resiliency. Around this a section of a sheet of Abrasive Paper (9" x 11") may be folded.

If the school shop is equipped with mechanical devices such as drum sanders or belt sanders using some form of hand block to bring the belt in contact with the surface to be sanded, much hand work may be eliminated. Such flat surfaces as desk tops, table tops, doors, bed parts, etc., may be finished by such means as are employed by industry.





A triple drum sander (one with three cylinders, each covered with abrasive paper) will do good work with such grits as Nos. 1-1/2, 1/2, 2/0 where sanding *solid* wood. The first, or coarsest number, does the most cutting, the second continues the cutting but not so deeply, leaving a smoother surface and less work for the last drum, whose function is only to smooth the surface and remove any marks left by the preceding and coarser numbers.

PLYWOOD (built up with a core and sheets of veneer) requires that finer numbers be used, such as 1/2, 0 and 2/0 or 3/0, to prevent cutting through the thin veneer. Except in very large quantities it is better to sand by belt only.

In most plants the drum sander is used only as a first step in preparing the surface and the work is then taken to a belt sander for what is usually the final sanding. Grits 0, 2/0, 3/0 and even 4/0, are used for the purpose, but as a rule if a finish as fine as 3/0 or 4/0



DISC SANDER



SPINDLE SANDER

is required, these numbers are preceded by an extra belt-sanding with 0 or 2/0.

There are many other types of machines used for sanding all kinds of odd shapes such as the depressions in chair seats, toilet seats made of wood, chair arms, furniture legs, mouldings, etc. These operations require a heavy paper or a cloth, heavy or light, depending on the pliability necessary. The abrasive material may be made into the form of discs used on a flat revolving plate, sleeves to fit over

a fast running spindle or drum, or belts designed to sand all kinds of angles and curves. Abrasive Paper may be used for discs or sleeves where its shape is not required to change while in use and flexibility is not necessary.

PORTABLE DISC SANDER





## *Abrasive Cloth Operations*

For miscellaneous belt sanding, abrasive cloth is necessary. To sand irregular surfaces it must be capable of constantly changing its form so as to come in contact with every part of the surface over which it travels. Also because of sharp corners or edges in the work, strength is required to prevent breaking or tearing.

As mentioned before, Cloth is made in two weights, heavy and light, and selection depends on the requirements of the work. In some instances strength is more important than flexibility; in others extreme flexibility is necessary and strength is of secondary importance.

To illustrate, sanding the heavy saddle seat of an office chair requires the abrasive material to do heavy cutting, but the curves are gradual and the depression not deep. Heavy cloth has the necessary strength and sufficient pliability.

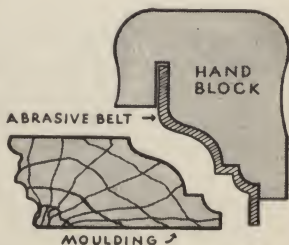
But the sanding of mouldings such as used around furniture tops or in strips for decorating all sorts of cabinet work, requires extreme flexibility. There may be many sharp angles or curves in the same moulding, all of which may be sanded at one time if the cloth is soft and pliable enough to conform. Strength is secondary, for the strain is light because very little of the surface is sanded away.

In doing this moulding work, a wood block is used which has one face cut to the exact shape of the moulding but just reversed



*(Note variety of hand-blocks on the shelves)*

so they fit together like two pieces of a Jigsaw puzzle. (See illustration below.) Then with the abrasive belt running lengthwise directly over the face of the moulding with the grit side toward it, the block is pressed down into position and worked back and forth. The face of the block and the face of the moulding fitting together, with the belt between, force the belt tightly into or over every curve and angle, leaving a smooth finish.



## *Sanding Color and Protective Coatings*

Now assume the object has been assembled and has been touched up by hand where necessary. It still must receive further abrasive treatment if the finish is to be attractive. If it is a door, mantel, bookcase or some sort of trim, this probably will be done on the job. If it is a piece of furniture it should be finished immediately to prevent warping and to protect any glue from moisture.

If it is to be varnished, lacquered or waxed, the procedure is as follows:

First, stain, unless it is to be finished natural. Then coat with a solution of shellac (40% white shellac and 60% alcohol). This fills the surface, holds the fine wood fibres, which may have been raised so that the surface is rough, and protects the stain during the sanding which follows. Garnet Finishing Paper (light and flexible), in grit 5/0, should now be used by striking lightly over the entire surface until all roughness has disappeared. Follow this with filler, which is wiped off clean after allowing time for part of it to settle into the grain. The filler coat requires no sanding.

If a waxed finish is desired, one or two coats of full strength white shellac should then be applied, but not until filler is thoroughly dry. Sand smooth after each coat with 5/0 Garnet Finishing Paper. Then apply the wax. If varnish or lacquer is to be used, it should follow the filler. The number of coats depends somewhat on the finishing material, but not more than four coats of lacquer or three coats of varnish should be required.

Sand between coats lightly with 7/0 Garnet Finishing Paper. The final coat may be rubbed with powdered pumice stone and oil or water. Water with pumice stone produces a dull finish — oil yields a more lustrous one. A high gloss is obtained with a final rubbing with Rotten Stone and Lemon Oil.

### *Aluminum Oxide in Wood Working*

While Abrasive Papers coated with Garnet are still generally the most popular in wood-working, the manufactured mineral, Aluminum Oxide, has supplanted garnet in an increasing proportion since 1925. For severe jobs such as sanding wood floors by machine, and in large industrial plants where hardwood is being continuously fed to high-speed machines, Aluminum Oxide, even at a higher initial price, gives a lower final cost per unit of work.

The Behr-Manning brand for Aluminum Oxide Paper and Cloth is "**LIGHTNING ADALOX.**" (See note on page 26.)

"Adalox" is made in the same grits, sizes and backings as Garnet, of which a list is given on page 21.



For intermittent machine work or for sanding by hand, Garnet will be found to give perfect satisfaction and is therefore recommended.

### *Flint Paper*

The most commonly known form of abrasive paper is Flint Paper, sold by the hardware or paint store. It is the cheapest in price and, if used in its proper sphere, fairly efficient, though it should never be looked upon as a production tool.

Flint is not so tough as the other minerals used for wood-work, but for removing old paint from furniture and interior trim, where the gummy coatings clog the surface of the sheet without real exhaustive wear on the mineral grains, Flint Paper, because of its low price, may be indicated.

Usually it is best to take off the old finish down to the wood, and to do this, Flint Paper No. 2 (or perhaps No. 2-1/2) should be used.

Behr-Manning brands of Flint Paper are:

"Troy" in 9" x 11" sheets.

"Mohawk" in 8<sup>3</sup>/<sub>4</sub>" x 10<sup>1</sup>/<sub>2</sub>" sheets.

NOTE: After the old finish has been removed the succeeding operations on the bare wood are better handled with Garnet Finishing Paper No. 2/0 followed by No. 4/0. If the surface is to be repainted, a primer should be used. When it is thoroughly dry it may be satisfactorily smoothed out with No. 4/0 Garnet Finishing Paper so that no brush marks or irregularities will show.

## *Recommendations for Wood Work*



FOR HAND WORK on all Woods:

Garnet Paper, sheets 9" x 11".\*

FOR HAND WORK on Shellac, Lacquer, Varnish,  
etc.:

Garnet Finishing Paper, sheets 9" x 11".†

FOR DRUM SANDER, All Woods:

Garnet Paper in rolls (Closekote).

FOR BELT SANDER, Industrial Machine, Ordinary Flat Work:

Garnet Paper in narrow rolls (Closekote).

FOR BELT SANDER, Industrial Machine, Odd Shapes, requiring strength rather than flexibility in the backing:

Garnet Cloth "X" in rolls (Closekote).

FOR BELT SANDER, Industrial Machine, Moulded Work where extra pliability is necessary:

Garnet Cloth "J" (Closekote).

FOR BELT SANDER, Portable Machine:

Garnet Cloth "X" in rolls (Closekote).

FOR DISC SANDER, All Woods:

Garnet Paper in rolls or discs (Closekote).

FOR HAND WORK on Painted Surfaces:

Flint Paper, sheets.\*\*

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\* Made in both Openkote and Closekote (Openkote recommended).

† Made in Openkote only.    \*\* Made in Closekote only.  
See "Closekote" and "Openkote," page 28.



## *Grit Ranges of Wood Working Abrasives:*



Garnet Paper 9" x 11":

Grits 4/0 (Fine) to 3½ (Very Coarse).

Garnet Finishing Paper 9" x 11":

Grits 8/0 (Very Fine) to 0 (Medium Fine).

Garnet Roll Paper:

Grits 6/0 (Very Fine) to 3½ (Very Coarse).

Garnet Cloth X (Heavy):

Grits 3/0 (Fine) to 3 (Coarse).

Garnet Cloth J (Light):

Grits 4/0 (Fine) to ½ (Medium).

Troy Flint Paper 9" x 11":

Grits 4/0 (Fine) to 3 (Coarse).

Mohawk Flint Paper 8¾" x 10½":

Grits 3/0 (Fine) to 3 (Coarse).

### *Important Note:*

Industry has found products superior to the old Flint Paper, and Manual Training Schools and Home Artisans will do well to follow in its path and clearly specify *Garnet* Paper, *Garnet Finishing* Paper and *Garnet* Cloth, as indicated. Samples will gladly be furnished.

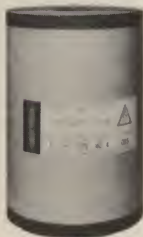
## *Metal Working Abrasives*

Aluminum Oxide is the standard metal-cutting abrasive in all production shops. Except for a very bright final polish, Emery Cloth is no longer a factor in Industry.

If the Manual Training Department is doing any metal work, the abrasive indicated is Aluminum Oxide, the hardest, toughest and sharpest mineral for this purpose.

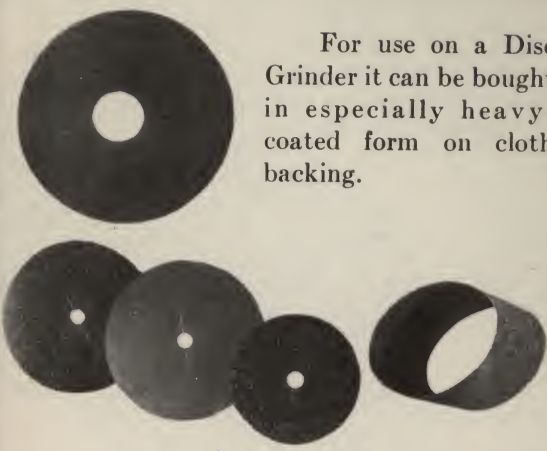
**LIGHTNING METALITE CLOTH** (Aluminum Oxide) for use by hand, is sold in sheets 9" x 11" or in narrow rolls 1", 1½" and 2" wide.

(See pages 26-27.)



**METALITE CLOTH** (Aluminum Oxide) — for use in endless belts, is put up in rolls up to 27" wide by 50 yards long.





For use on a Disc Grinder it can be bought in especially heavy-coated form on cloth backing.

For a portable disc sander driven by flexible shaft, it is coated on a backing consisting of cloth and hard fiber joined.

Used as a sleeve on a flexible shaft machine, Aluminum Oxide on Cloth is the proper abrasive.

For all metal cutting jobs Metalite Cloth is the material to use.

"Metalite," an easy name to remember, is the Behr-Manning brand for Aluminum Oxide metal-cutting materials. It is made in grits 320 (very fine) to 24 (very coarse).

### *Automobile Body Finishing*

In some schools this feature has been carried on in the Manual Training Departments. It is worthy of some recommendations as to the best way of doing the job because it



also indicates a good procedure for other metal objects which may be lacquered.

#### METAL CLEAN UP.

This is best handled by ***LIGHTNING METALITE CLOTH*** (Aluminum Oxide) grits 80 and 120.

#### PRIMER.

The primer coat does not need sanding if properly applied. If necessary use **ADALOX PAPER** (Aluminum Oxide) either 5/0 or 4/0.

#### PUTTY GLAZE

Scuff lightly with **ADALOX PAPER** 5/0 or 4/0.

#### SURFACER.

For most Sanding Surfacers use 240-C or 280-C ***Speed-wet*** (Waterproof) Abrasive Paper (Silicon Carbide) followed by a 280-A or 320-A ***Speed-wet*** for further smoothing. Use plenty of water, as ***Speed-wet*** is designed for such practice.

If surfacer is to be sanded dry or with gasoline, DURITE (Silicon Carbide) or ADALOX (Aluminum Oxide) Papers in grits No. 2/0-100C to 6/0-220A indicated.

## LACQUER.

Only the last coat requires rubbing. *Speed-wet* (Waterproof) Paper No. 240-A, 280-A or 320-A is recommended. For touch-up work, No. 400-A insures a beautiful silky finish.

## ENAMELS AND JAPANS.

*Speed-wet* (Waterproof) Papers are recommended. If a two-coat finish is to be applied after sanding, use 240-C. For one-coat finish use 320-A or 400-A.

The new quick drying "Synthetics" require but a light scuffing with the very fine No. 500-A or 600-A *Speed-wet* (Waterproof) paper.

## EXPLANATORY NOTE:

Symbols A, C and D indicate varieties of weight in the paper backings as follows:

A—Very light      C—Medium      D—Heavy

Behr-Manning registered brands follow:

METALITE	—Aluminum Oxide Cloth	} For use dry
ADALOX	—Aluminum Oxide Paper	
DURITE	—Silicon Carbide Paper	

<i>Speed-wet</i>	—Silicon Carbide Paper (Waterproof)	} For use with water

# LIGHTNING

*Our Registered Trade Mark for  
a Revolutionary Achievement in  
Coated Abrasive Manufacture*

Abrasive papers and cloths on which the individual cutting grains are *controlled by electrostatic force* as to just *how* and *where* they will stand on the finished goods, are now commercial products.

To appreciate fully what this improvement means, it must be realized that the best shaped grains for coated abrasives are from two to three times as long as they are wide or thick. Hence the great difference it makes to have them *stood on end* with their sharpest edges to the work, instead of *lying down* on the backing.



*Electrocoating stands them up.* They are compelled to obey the vertical lines of force in a powerful electrostatic field.

Prior to the introduction of **LIGHTNING** sandpapers, the procedure was to drop masses of grains on glued paper or cloth backing where they became affixed in haphazard position. Some of them lay down, some rested on others, while many of them stood up.

In direct contrast, by the electrocoating process, whether grit 9/0, with 609,000 grains to the square inch, or 2/0 with about 27,500

to the inch—the grains are separately charged in the electric field, disciplined by this electric force and the crystals, large or small, have to stand as soldiers—*alert, heads up and ready for duty.*

The electric force does another thing equally important. It disperses or spaces the grains. All grains, having a like charge, repel one another and as this repulsion takes place evenly, correct and equal spacing in relation to one another results.



Instead of a disorderly mob, we have an army under the strictest order of an immutable force, heads up, perfect precision in spacing—like soldiers on inspection.

This gives the greatest number of sharpest cutting edges, uniformly coated, in contact with the work to be sanded—the ideal condition in a coated abrasive, which is judged according to its cutting ability and by the finish it produces.

*Under all the varying conditions, the difference ranges generally from 20% to 50% increased efficiency.*

Remember the name “**LIGHTNING**” as the simplest way of identifying and receiving electrocoated sandpapers.

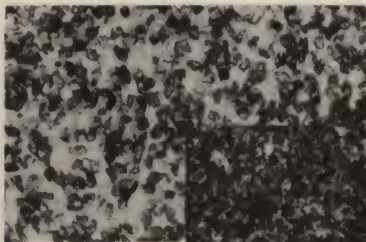
## **“CLOSEKOTE” and “OPENKOTE”**

*Registered Trade Names of Behr-Manning*

These trademarked terms describe the quantity of mineral applied.

Closekote, by far the more general in use, is one in which the abrasive is applied in such quantity as entirely to cover the backing.

In Openkote the backing is only approximately 50% covered. This leaves wider spaces between the abrasive grains. Recommended both for increased pliability and cutting speed under light pressures or where the material sanded is of such nature as to fill up the surface.



**“OPENKOTE”**



**“CLOSEKOTE”**



# APPROXIMATE COMPARISON OF GRIT NUMBERS

ARTIFICIAL*	GARNET	FLINT	EMERY
600			
500			
400-10/0			
360			
320-9/0		7/0	
280-8/0	8/0	6/0	
240-7/0	7/0	5/0	
220-6/0	6/0	4/0	
180-5/0	5/0	3/0	3/0
150-4/0	4/0		2/0
120-3/0	3/0	2/0	
100-2/0	2/0	0	0
80-0	0	1/2	1/2
60-1/2	1/2	1	1 1/2
50-1	1	1 1/2	2
40-1 1/2	1 1/2	2	2 1/2
36-2	2	2 1/2	
30-2 1/2	2 1/2	3	3
24-3	3		
22-3 1/4			
20-3 1/2	3 1/2		
18-3 3/4			
16-4			
14-4 1/4			
12-4 1/2			

\* Includes Adalox — Durite — Metalite — Speed-wet.

## IMPORTANT

In order to insure the finest quality Abrasive Papers and Cloths, we suggest your ordering and insisting on the following brands:

Behr-Manning Garnet Paper and Cloths for wood-working.

Behr-Manning "Lightning Metalite" Cloth for metal working.

Behr-Manning "Speed-Wet" (Waterproof) for water sanding.

Behr-Manning "Adalox" Paper and Cloth and "Durite" Paper for purposes indicated in the text.

Schools need not worry along with Flint Paper and Emery Cloth when *Garnet* Paper and *Aluminum Oxide (Lightning Metalite)* Cloth have completely superseded them in commercial use. Likewise, for fine lacquer finishes on metal, water-sanding with *Speed-wet* Waterproof Paper is the fastest, best and most economical.





Behr-Manning, as manufacturers of the very highest type of Coated Abrasives with an experience dating back to 1872, possess the largest and most modern plant solely devoted to the making of these products. This includes Testing and Research Laboratories constantly guarding and improving the quality of output and a Service Department anxious to co-operate in solving any sanding problem.

In addition to the Home Office at Troy, N. Y., stocks are carried in branches in the following cities:

Boston.....	716 Columbus Avenue
Buffalo.....	56 Pearl Street
Chicago.....	1330 South Canal Street
Cincinnati.....	228 West Seventh Street
Cleveland.....	1306 East 55th Street
Detroit.....	5805 Lincoln Avenue
Grand Rapids.....	64 Ionia Avenue, S. W.
High Point.....	221 West High Street
Indianapolis.....	410 South Meridian Street
Los Angeles.....	138 West 17th Street
New York.....	125 Barclay Street
Philadelphia.....	4732 Stenton Avenue
St. Louis.....	1531 Washington Avenue
San Francisco.....	230 Eighth Street
Tacoma.....	315 South 23rd Street

and by Jobbers and Dealers throughout the country.

**BEHR-MANNING, TROY, N. Y.**

*Makers of Quality Abrasive Papers and Cloths  
Since 1872*

*Sales Representatives in the United States for*

**NORTON ABRASIVES**

**India Oilstones  
Crystolon Oilstones  
Hard Arkansas Oilstones  
Washita Oilstones  
And other Abrasive Specialties**

*Our Attractive Booklet*  
**"HOW TO SHARPEN"**  
*Is Free for the Asking*





**BEHR-MANNING**

*The Sandpaper with "Barney" the Bear*